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Microbial Burden Prediction Model Program: Production Version

The problem:

To predict the number of viable micro-organisms accumulated on the biologically significant surfaces of a spacecraft at selected times during the preparation and testing operations prior to launch.

The solution:

A mathematical model and a computer program that together will predict the microbial loading on any spacecraft.

How it's done:

The model supplements biological surveys of the spacecraft by simulating the microbial burden accumulation processes during periods when surveys are not taken. An important application of the model is to predict the microbial loading on a spacecraft landing capsule immediately prior to terminal heat sterilization.

Mathematical expressions were developed to represent the processes of burden accumulation and to reflect the effects of the parameters on each process. Three burden accumulation processes (1, 2, and 3) and one burden reduction process (4) were identified: (1) environment fallout; (2) personnel and equipment fallout; (3) contact by tools or personnel; and (4) decontamination.

Due to uncertainties in parameter values and initial microbial burdens, it was necessary to treat these quantities as random variables. This was accomplished by the interval concept, a numerical technique for performing arithmetic operations of addition, multiplication and division on histograms (probability density functions) which are not necessarily from identical underlying distributions.

The computer program logic was based on five requirements: (1) the ability to simulate the assembly and test sequence of any spacecraft; (2) the ability to simulate the burden accumulation and reduction processes using the interval concept and the mathematical expressions developed; (3) the ability to compute and maintain statistics that describe the burden accumulated by each biologically significant zone at the selected points in the activity sequence; (4) the ability to maintain separate statistics for four surfaces (top, exterior, mated, and occluded) of each part or zone; and (5) input and output requirements.

The format of the computer input is extremely flexible. The input data consist of the burden parameters and the assembly and test sequence. The following inputs are supplied at appropriate activity levels: (1) part numbers of hardware being manipulated; (2) hardware area changes (e.g., the change from external to mated, caused by joining two parts); (3) environment designation; (4) number of personnel; (5) time to perform; (6) initial burdens on hardware and tools; (7) burden retention factors for hardware and tools; and (8) prerequisite activities.

The computer prints out the burden histogram for each surface of each part or zone whenever it is affected by an operation. Burden totals for each surface are printed at the end of each task unless a complete listing of burden histograms for each surface of every part and zone is requested.

(continued overleaf)

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Notes:

1. This program is written in FORTRAN V for use on the UNIVAC-1108 computer.
2. Requests for further information may be directed to:

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   112 Barrow Hall
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   Reference: B71-10401

Patent status:

No patent action is contemplated by NASA.

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